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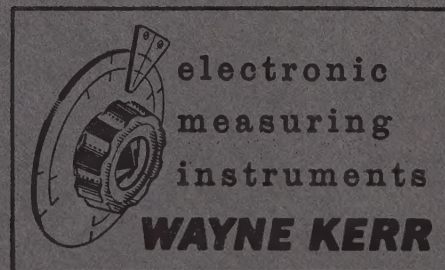
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MR. POKK

Test gear

INSTRUCTION MANUAL

Q801A
Q801



Transistor Adaptor Q801A

and

D. C. Control Unit Q801

INSTRUCTION
MANUAL

THE WAYNE KERR LABORATORIES LIMITED

Sycamore Grove

New Malden

Surrey

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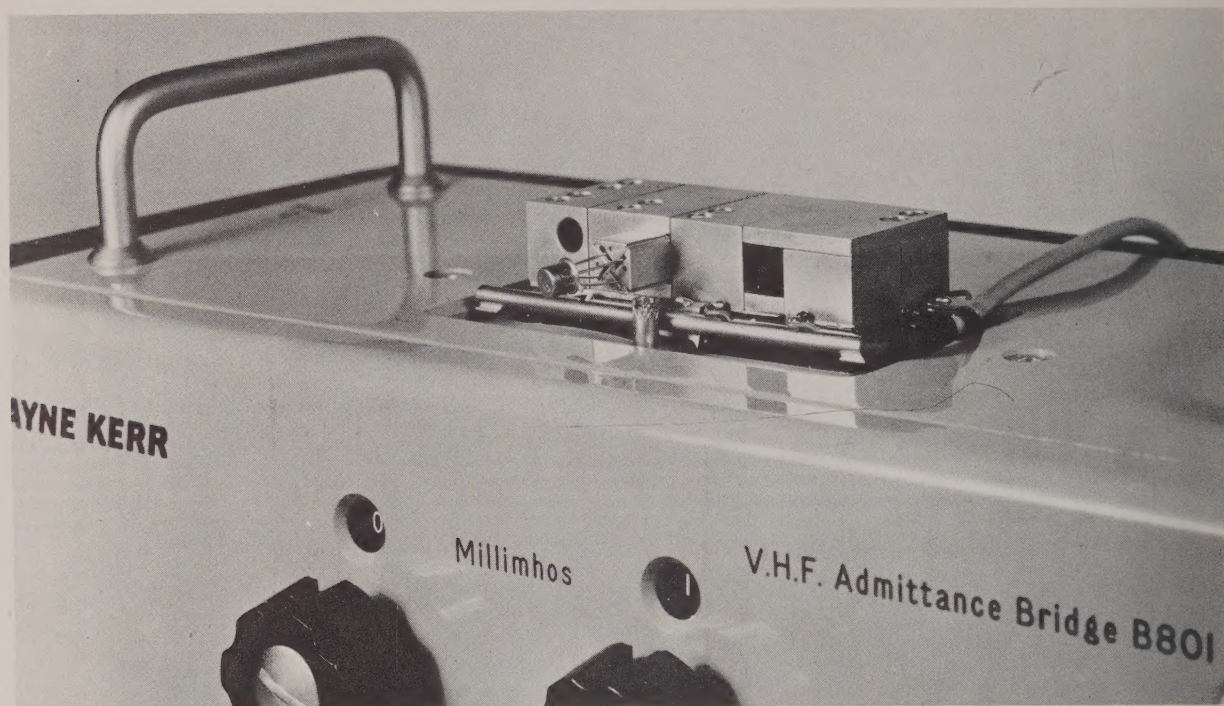


Fig. 1 Transistor Adaptor Q801A

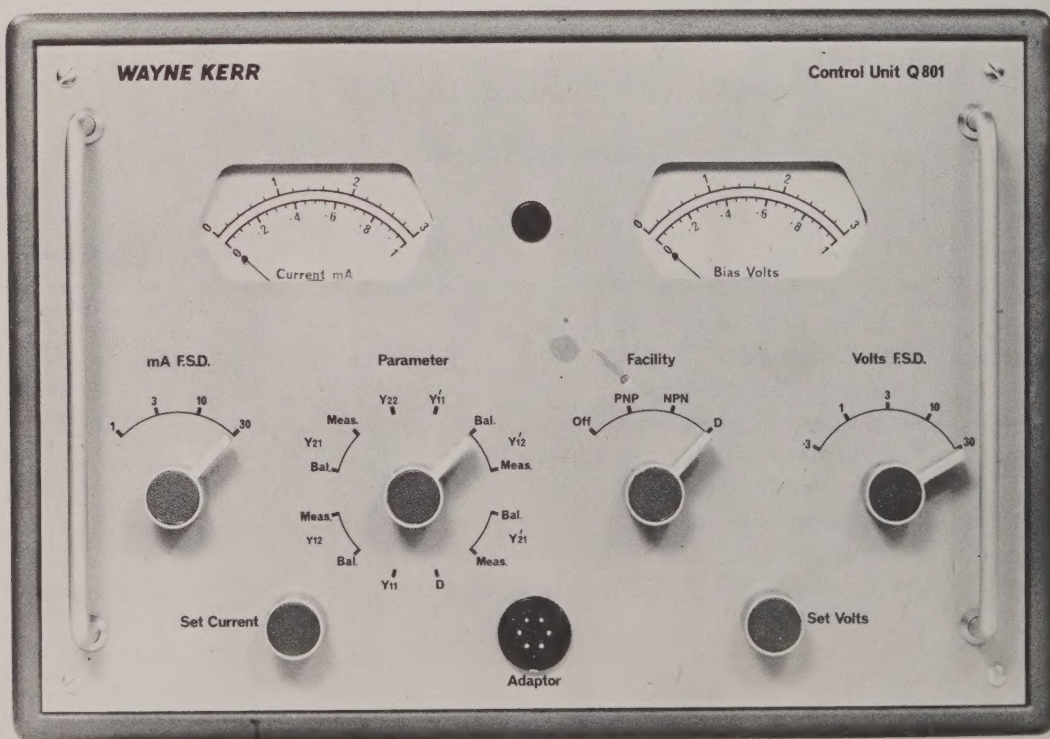


Fig. 2 D. C. Control Unit Q801

INTRODUCTION

Transistor Adaptor Q801A and its associated Control Unit Q801 have been designed to enable the VHF Admittance Bridge B801B to measure the small signal Y parameters of transistors over the bridge frequency range of 5 - 100Mc/s. The full range of measurement, of capacitance 0 to $\pm 230\text{pF}$, and conductance 0 to 100millimhos, provided by the bridge can be used for transistors mounted in the adaptor and provided with d. c. bias from the control unit. The lower half of the adaptor is a decoupling block assembly comprising chokes and capacitors so that the d. c. bias can be applied without affecting the parameter measurements.

A special loader which slides into the adaptor block accommodates transistor leads up to $1\frac{1}{2}$ in. No other connections are necessary and thus errors arising from varying lead dispositions are eliminated. According to whether the loader is inserted from the back or front into the left or right hand channel, so the four Y parameters in common-base or common-emitter configurations can be measured.

The Control Unit provides d. c. bias for pnp, npn transistors and diodes or tunnel diodes. The d. c. current is 0 to 30mA in 4 ranges and the d. c. voltage 0 to 30V in 5 ranges.

The bridge gives direct readings of the capacitance and conductance of the transistor parameter.

SPECIFICATION

Transistor Adaptor Q801A

Parameters measured:

Common base	Y_{11} Y_{12} Y_{21} Y_{22}
Common emitter	Y'_{11} Y'_{12} Y'_{21} Y'_{22}
Diodes	Parallel conductance and capacitance.

Frequency range:	5 to 100Mc/s
Conductance range:	0 to ± 100 millimhos
Capacitance range:	0 to ± 230 pF
Discrimination:	G: 0.02 millimho (5 to 50Mc/s) 0.1 millimho at 100Mc/s C: 0.2 pF (5 - 100Mc/s)

Accuracy:

2-terminal measurements:	G: $\pm 2\%$, ± 0.1 millimho C: $\pm 2\%$, ± 1.5 pF
3-terminal measurements:	up to 50Mc/s, as for 2-terminal 50 to 100Mc/s, $\pm 10\%$ on modulus ± 1 pF ± 0.1 millimho

Dimensions:	Length: 3 in. (7.6 cm) Width: $1\frac{1}{4}$ in. (3.2 cm) Depth: 1 in. (2.5 cm)
-------------	---

Weight (boxed): $1\frac{3}{4}$ lb. (0.62 kg)

Specification cont.

D. C. Control Unit Q801

Power supplies:

Battery operated

Four 12V Ever Ready type B1578
Batteries

Output:

Maximum 300mW

Current ranges:

0 to 1, 0 to 3, 0 to 10 and 0 to 30mA f. s. d.

Voltage ranges:

0 to 0.3, 0 to 1, 0 to 3, 0 to 10 and
0 to 30V f. s. d.

D. C. Accuracy

 $\pm 2.5\%$ f. s. d.

Dimensions:

Width: 13.25 in. (33.6 cm)

Height: 9.25 in. (23.5 cm)

Depth: 8.75 in. (22.2 cm)

Weight: 12 $\frac{1}{2}$ lb. (5.7 kg)

OPERATING INSTRUCTIONS

Setting Up

- 1 Connect the Bridge Source S161B and the Bridge Detector R161 to the VHF Admittance Bridge B801B.
- 2 Mount the Transistor Adaptor Q801A on the bridge as follows:
 - (a) Remove the existing terminal block on the top of the bridge by loosening the two holding screws and the ground terminal. After lifting off the terminal block unscrew the lower terminal on the chassis ground connection post.
 - (b) Fit the Adaptor in place of the terminal block, securing it by means of the two screws removed with the terminal block.
 - (c) Make good the chassis ground connection with the special washer or link-block and terminal contained in the adaptor box (see fig. 1).
 - (d) Take the lead from the Adaptor and plug it into the Control Unit Q801.
- 3 Insert the transistor into the adaptor by pushing the connecting wires into the slots (marked with green, blue, black and two red dots) in the end of the loader. See Table 1.
- 4 Push the loader into the adaptor with the red dots uppermost.

Note: Table 1 lists the slots into which the transistor leads are placed and gives the loading position in the adaptor. Where there is a fourth lead (screen), this may be placed in the fourth slot, or with one other lead in a slot, or bent back as required.

Note: Fig. 3 shows the positions of the dots at one end of the loader. Thus, starting from the position with the two red dots uppermost and going clockwise round the loader, the coloured dots are in the order blue, black, green.

The letters A, B, N denote the connections to the decoupling block, which are made automatically when the loader is inserted as specified.

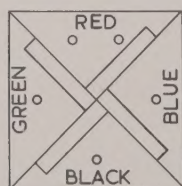


FIG. 3. LOADER COLOUR CODING

The loader must always be inserted to the same depth in the adaptor when balancing with the trim controls or using the front controls on the bridge.

Table 1 - Loader connections

PARAMETER	Emitter	Base	Collector	LOAD AT
Y_{11} (2-terminal)	Black (A)	Blue (B_2')	Red (B_1')	Left, Front
Y_{12} (3-terminal) Bal.	Blue (B_2')	Red (N_2')	Green (N_1')	Right, Rear
" " Meas.	Blue (B_2')	Red (N_2')	Black (A)	Right, Rear
Y_{21} (3-terminal) Bal.	Red (N_2')	Black (A)	Blue (N_1')	Right, Front
" " Meas.	Black (A)	Blue (N_1')	Green (B_2')	Right, Front
Y_{22} (2-terminal)	Blue (B_2')	Red (B_1')	Black (A)	Left, Front
Y'_{11} (2-terminal)	Green (B_1')	Black (A)	Blue (B_2')	Left, Front
Y'_{12} (3-terminal) Bal.	Red (N_2')	Green (B_2')	Blue (N_1')	Right, Front
" " Meas.	Red (N_2')	Green (B_2')	Black (A)	Right, Front
Y'_{21} (3-terminal) Bal.	Black (A)	Red (N_2')	Green (N_1')	Right, Rear
" " Meas.	Green (N_1')	Black (A)	Blue (B_2')	Right, Rear
D (Diodes) +ve to Black (A), -ve to Green and/or Red (B_1')				Left, Front

The definition of the Y parameters measured with the transistor adaptor and control unit are detailed in Table 2 below.

Table 2: Definition of Y Parameters

Parameter	Ratio	Common base	Common emitter
Input admittance	I_{in}/V_{in}	Y_{11}	Y'_{11}
Reverse transfer admittance	I_{in}/V_{out}	Y_{12}	Y'_{12}
Forward transfer admittance	I_{out}/V_{in}	Y_{21}	Y'_{21}
Output admittance	I_{out}/V_{out}	Y_{22}	Y'_{22}

Note: $Y_{22} = Y'_{22}$

Measurement Procedure

It will be seen from Table 1 that both 2-terminal and 3-terminal measurements are made, input admittance Y_{11} Y'_{11} and output admittance being 2-terminal measurements, reverse transfer admittance Y_{12} , Y'_{12} and forward transfer admittance Y_{21} Y'_{21} being 3-terminal measurements. The procedures are detailed below.

The parameters are sensitive to the input a. c. signal level and, to ensure true small signal conditions, the signal from the source must be reduced to a value such that a small change in the level does not change the measured value of the parameter.

In general Y_{11} and Y_{21} parameters require smaller signal levels than Y_{12} and Y_{22} . In the latter case, the signal should be as high as is permissible in order to obtain the discrimination required.

2-terminal measurements

- 5 Insert the loader into the adaptor without a transistor, switch on the source and set it to the frequency required.
- 6 Set all front panel controls on the bridge to zero.
- 7 Switch on the detector, set it to the required frequency and insert headphones.
- 8 Set the Parameter switch on the control unit to the parameter required and set the Facility switch to PNP, NPN or D as applicable.
- 9 Set the mA F. S. D. and Volts F. S. D. switches to the required ranges and turn the Set Current and Set Volts potentiometers fully counter-clockwise.
- 10 Balance the bridge using the trim controls only.
- 11 Adjust the source signal to a low level with maximum gain on the detector.
- 12 Remove the loader from the adaptor and insert the transistor as directed in Table 1; replace the loader in the adaptor.
- 13 Set the required d. c. current and voltage levels on the control unit and balance the bridge using the controls on the front panel.
- 14 Read the conductance (G) and capacitance (C) shown on the bridge.

3-terminal measurements

These measurements are made in two stages, balance (Bal) and measure (Meas) and in each case the method of inserting the transistor into the loader is as shown in Table 1.

- 15 Switch off the bridge source and set all front panel controls on the bridge to zero.
- 16 Balance the bridge as follows:
 - (a) Set the Parameter switch to Bal at the parameter required and set the Facility switch.
 - (b) Insert the transistor into the loader and place the loader in the adaptor.
 - (c) Set up the d. c. conditions required on the control unit.
 - (d) Set the source and detector to the required frequency.
 - (e) Balance the bridge using the trim controls and adjust the a. c. signal level as in 11 above.
 - (f) Remove the loader.
- 17 Make measurements as follows:
 - (a) Set the Parameter switch to Meas.
 - (b) Take out the transistor and reinsert into the loader in the Meas position as shown in Table 1.
 - (c) Replace the loader in the adaptor and balance the bridge using the front panel controls.
 - (d) Read the values of conductance (G) and capacitance (C) shown on the bridge.

Note: When measuring Y_{21} the conductance (G) dial on the bridge must be offset by means of a shunt resistor in the adaptor. These resistors, 10Ω (100 millimhos), 20Ω (50 millimhos), will be found in the adaptor box. Insert one into the adaptor, set the G decade to the corresponding value (G off-set), and balance the bridge with the trim controls.

The value of G now read on the bridge will be:

$$G'_{21} = -(G_{\text{off-set}} - G_{\text{Meas}}) \text{ millimhos}$$

For 2-terminal measurements

The admittance $Y = G + j\omega C$

For 3-terminal measurements

The admittance $Y = -G - j\omega C$

where G and C are the conductance and capacitance values measured on the bridge. The minus signs given for 3-terminal measurements are to conform with conventional 'Black Box' theory.

Note: For details of measurements of diodes and tunnel diodes see pp. 18 and 19.

GENERAL DESCRIPTION

The transistor adaptor type Q801A is shown in fig. 1. It consists of a series of brass blocks mounted on a moulded base and insulated from each other. They are so arranged that two identical square apertures are left into which the transistor mounting assembly slides. In addition, to one side, is a circular aperture into which the special shunting resistors can be placed. This method of assembly is very durable and dispenses with the need for connecting leads to the transistors or diodes under measurement.

The transistor Adaptor Q801A is packed in a specially designed wooden box inside which is contained, in moulded plastic foam;

The transistor adaptor with lead and plug
 The transistor loader
 Two special shunting resistors of 10Ω and 20Ω
 A special terminal and washer or link-block
 for ground connection.

The box is fitted with a simple latch lock and the adaptor and associated pieces should always be kept in the box when not in use.

The facilities provided on the Control Unit Q801 front panel are:

Current indicator, M1:	Shows the direct current in mA taken by the emitter of the transistor in the adaptor.
------------------------	---

Bias volts indicator, M2:	Shows the d. c. voltage applied to the collector-base of the transistor in the adaptor.
mA F. S. D. switch, SW3:	4 position current range switch selects required range (1, 3, 10 or 30mA f. s. d.) and limits the maximum current to approx. 20% overload on each range.
Set Current Potentiometer, RV4:	Sets the d. c. current applied to the transistor in the adaptor on the bridge. The value is shown on the current indicator.
Volts F. S. D. switch, SW4:	5-position switch giving five ranges (0.3, 1, 3, 10, 30V f. s. d.) the two lower ranges being primarily for diodes. The maximum voltage on each range is limited to protect the meter (and component being measured).
Set Volts Potentiometer, RV6:	Sets the d. c. voltage applied to the transistor in the adaptor on the bridge. The value is shown on the bias volts indicator.
Parameter switch, SW1:	12-position switch distributes the required d. c. bias to the appropriate positions on the adaptor for measuring the four parameters in two configurations and a position (D) for diodes and tunnel diodes.
Facility switch, SW2:	4-position* switch giving Off - PNP - NPN - D. The Off position disconnects the power supplies and short circuits the meter movements for transit purposes.

* Certain models have an additional Off position, i. e. PNP - Off - NPN - Off - D.

CIRCUIT DESCRIPTION

Transistor Adaptor Q801A

The transistor adaptor provides a means of coupling a transistor to the B801B bridge and is so designed that d. c. bias may be applied without altering the value of the Y parameter to be measured.

It is constructed in two parts, viz. the decoupling block assembly and the channel block assembly.

Decoupling block assembly (see circuit diagram)

The decoupling block assembly is a nylon moulding containing the bridge contact terminals and the isolating components, viz:

four high impedance (low Q) chokes

$$L_{B1} \quad L_{B2} \quad L_{N1} \quad L_{N2}$$

four d. c. blocking capacitors

$$C_{B1} \quad C_{B2} \quad C_{N1} \quad C_{N2}$$

The capacitors are silvered ceramic wafers of $0.1\mu\text{F}$ with a low series inductance, less than $0.5\text{m}\mu\text{H}$ at 100Mc/s , $|Z|$ being less than $\pm 0.35\Omega$. The ferrite bead chokes have an inductance of $17\mu\text{H}$, $|Z|$ being more than $\pm 500\Omega$ between 5 and 100Mc/s . Therefore the rejection ratio X_C/X_L is less than $1/1000$ throughout the frequency range of the bridge.

Channel block assembly (see circuit diagram)

The channel block assembly is made up of alloy connecting pieces screwed to the decoupling block so as to change the geometry of the decoupling block terminals to form two channels with four sides each. The four section transistor loader is designed to hold TO5 or TO18 transistors but can accept other configurations. By inserting the loader in either channel from the back or front, 4 ways of connecting the transistor to the bridge are provided without crossing or changing the position or length of any connections.

When the transistor and loader are inserted into the adaptor in accordance with the parameters to be measured, as laid down in Table 1, the circuits in the adaptor are as shown in fig. 4 (a) to (n).

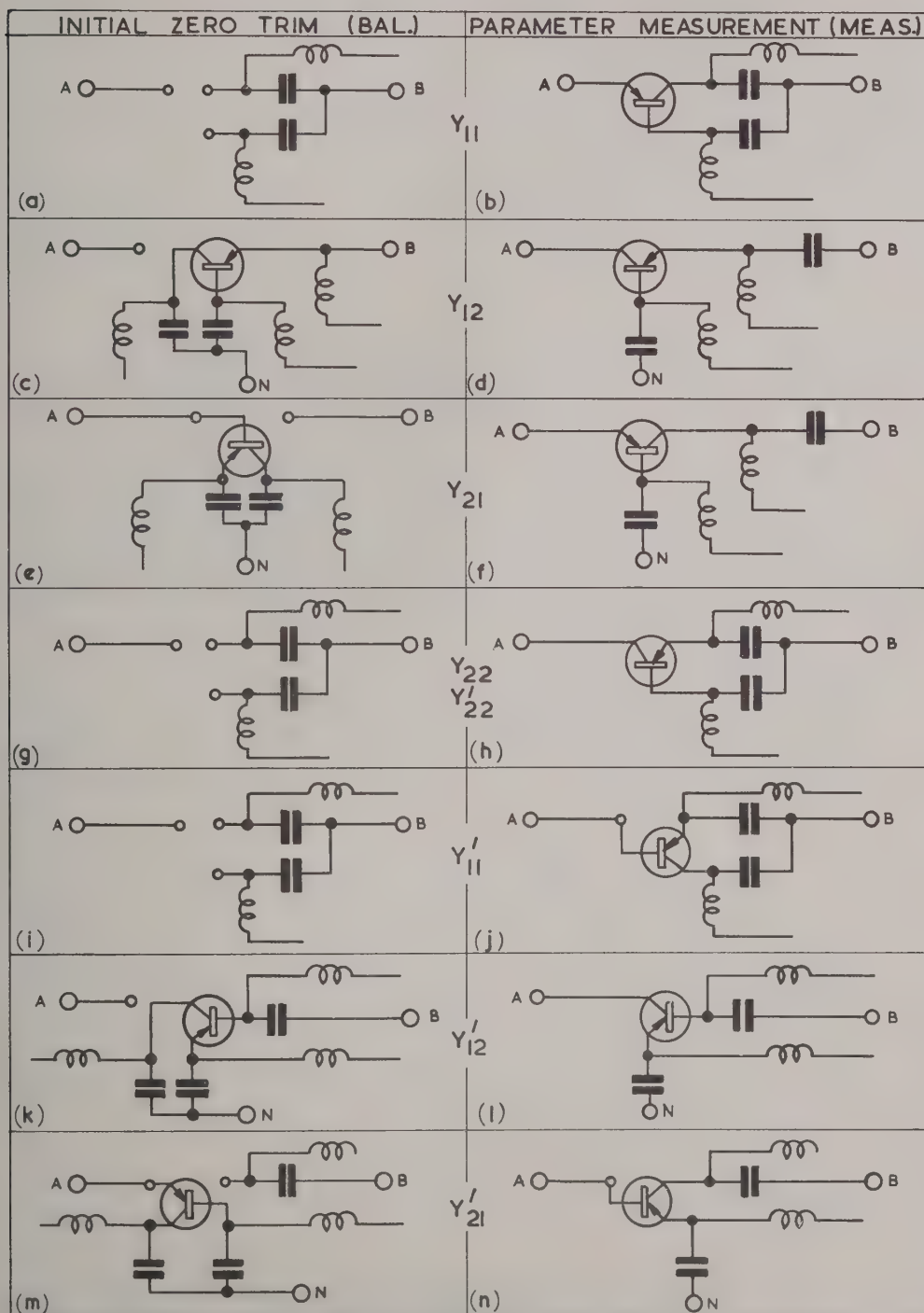


FIG. 4. MEASUREMENT CIRCUITS

D. C. Control Unit Q801 (see circuit diagram)

The control unit enables the operator to apply appropriate d. c. bias to the transistor whose parameters are to be measured and it is connected to the transistor adaptor by means of a 4 way screened cable.

The circuit may conveniently be divided into three sections:

- 1 D. C. current control section; this consists of current indicator M1, 12V battery B1, current range switch SW3, set current potentiometer RV4 and associated shunt and control resistors.
- 2 D. C. voltage control section; this consists of the voltage indicator M2, 36V battery B2, voltage range switch SW4, set voltage potentiometer RV6, multiplier and range resistors and the constant voltage circuits of VT1-3.
- 3 D. C. distribution section; this is connected to the above by means of the facility switch SW2 which controls the polarity of the d. c. bias applied. The section consists of the parameter switch SW1 feeding the programme board on which the five common connections A_1 B_1' B_2' N_1' N_2' are situated and from which connections are made to the transistor adaptor as shown.

D. C. current control section

The d. c. current control section works as follows. With the Facility switch (SW2) at PNP, the 12V battery B1 is switched across the Set Current potentiometer RV4. The current range switch (SW2) selects the appropriate range resistors R1 to R5 to enable RV4 to operate effectively and at the same time switches the appropriate shunt resistors (R5 to R10) across the indicator M1. The current output is connected to the programme board through wafer 1 of the Parameter switch SW1. The values of the components are such that the possible current overload is limited to 20%.

D. C. voltage control section

The d. c. voltage control section uses the same method of extending the sensitivity as the current control section. Wafer SW4/2A

connects the resistors R16 to R20 in series with the Set Volts potentiometer RV6. At the same time, wafer SW4/1B switches the multipliers R11 to R15 to enable the voltage indicator M2 range to be extended.

A constant voltage output is provided by means of the transistor circuit of VT1, VT2 and VT3. VT3 provides an emitter follower output to the switch wafer SW1/3. VT1 acts as a switch controlled by RV6 and drives VT2 at a level determined by the range setting, the position of RV6 and the circuit component values. The resistors R24 and R25 provide two alternative collector load resistors for the driver transistor VT2 and the output transistor VT3, depending on the range selected by switch SW4 (wafer SW4/2B), and limits dissipation to 300mW. The voltage indicator M2 is connected across the positive side of M1 and the emitter of VT3.

D. C. distribution section

The d. c. distribution section provides the means of switching the d. c. bias from the d. c. voltage control section to the programme board (A B₁ B₂ N₁ N₂) by means of Parameter switch SW1. The connections to the programme board and, hence, the loader, are arranged to suit the commonest transistor lead configurations, i. e. e, b, c in order. The 4-way screened cable carries the d. c. bias from the board to the adaptor terminals.

The resistor R26 and capacitor C2 reduce any tendency to low frequency oscillation and the diodes MR1-4 protect the transistors from excess voltage, due to the large capacitor C2, by limiting this to 1.2V between emitter and base.

Measurement

Transistors

Parameter signs occurring under most conditions are given in the following table:

Table 3 - Parameter signs

Parameter	Bridge indication		Parameter	
	Conductance	Impedance	Capacitance	Inductance
Z_{11}	-	-	-	-
Z_{22}	-	-	-	-
Y_{11}	-	-	-	-
Y_{22}	-	-	-	-
Z_{12}	-	-	-	-
Z_{21}	-	-	-	-
Y_{12}	-	-	-	-
Y_{21}	-	-	-	-

The following equations give the transposition from common base to common emitter configuration.

$$Y_{11} = Y'_{11} + Y'_{12} + Y'_{21} + Y'_{22} \approx Y'_{11} + Y'_{21}$$

$$Y_{12} = -(Y'_{12} + Y'_{22})$$

$$Y_{21} = -(Y'_{21} + Y'_{22})$$

$$Y_{22} = Y'_{22}$$

The current gains, frequency and power gain are given by the following expressions:

$$\text{Common Emitter Current Gain } (h'_{21}) = \frac{Y'_{21}}{Y'_{11}}$$

$$\text{Common Base Current Gain } (h_{21}) = \frac{Y_{21}}{Y_{11}}$$

$$f_T = \left| \frac{Y'_{21}}{Y'_{11}} \right| \times f \quad \text{where } f \text{ is any frequency on the 6dB/octave slope of } |h'_{21}|, Y'_{21} \text{ and } Y'_{11} \text{ measured at } f.$$

$$f_1 = \text{frequency at which } \left| \frac{Y'_{21}}{Y'_{11}} \right| = 1$$

$$f_1 = \frac{f_T \times f_2}{f_T + f_2} \quad \text{where } f_2 = \frac{1}{2\pi r_{bb'} C_c}$$

$$G_a = \frac{|Y'_{21}|^2}{4 G'_{11} G'_{22}}$$

Diodes

When the loader is inserted into the left front (2-terminal)

position with the two red dots uppermost and the Parameter and Facility switches are set to D, the loader sections marked with one green dot or two red dots are negative and the section marked with a black dot is positive. The voltmeter M2 circuit is automatically connected across the negative B1 block and the positive A block.

By suitably inserting the diode to be measured and selecting voltage ranges, forward voltages of 0V to 1V and reverse voltages of 0V to 30V can be set up.

By setting the Parameter and Facility switches to D, the current monitoring circuit is switched to register the current delivered by the d. c. voltage supply circuit and hence the current taken by the diode under test. The resultant current reading is a function of the voltage applied to the diode and its characteristic and is not separately controlled.

Measurement of the parallel C and G equivalent of the diode is made as operating instructions 5 to 14, p.10, for 2-terminal measurements of transistors.

Tunnel diodes

If the Parameter and Facility switches are set to D, measurements on tunnel diodes having two or three leads (two common) and operating on the positive slopes of their current voltage characteristics can be made according to operating instructions 5 to 14 as for normal diodes. For measurements in the negative slope region of tunnel diode characteristics, the 10 ohm or 20 ohm resistors supplied must be used in the adaptor location provided. The resistor is then automatically connected directly across the tunnel diode through a very low inductance path of approximately 3 milli-micro Henry and stabilises the tunnel diode at the working point. There may still be a tendency for some tunnel diodes to be unstable at the critical parts of the negative slope in spite of the presence of the resistors, but, usually, sufficient data can be obtained to plot the incremental slope resistance against voltage.

Since the shunt resistor is connected directly across the tunnel diode to obtain stability for measurements in the negative slope region of the characteristic, the d. c. current monitored is the sum of the tunnel diode current and that taken by the resistor, hence:

$$I_{TD} = I_M - I_R = I_M - V_{TO}/R \quad \text{where}$$

I_{TD} = current through tunnel diode

I_M = measured current

I_R = current through resistor

V_{TD} = voltage indicated across the tunnel diode

R = shunt resistor value

e. g. if:

$V_{TD} = 0.01$ volts

$I_M = 15$ mA

$R = 10$ ohms

then:

$I_{TD} = 15 - (0.10/10) = 5$ mA

The measurements obtained are $G + j\omega C$ where:

G = slope resistance of the tunnel diode

C = capacity of the tunnel diode

The signal level applied to the tunnel diode is approximately one fifth of the signal level applied to the B801B Bridge and should be kept to the minimum required for reasonable sensitivity. If a signal level which is too high is applied, there will be a tendency for the tunnel diode to switch and to obscure the balance.

MAINTENANCE

Note: If any fault is suspected, the bridge should be checked before the adaptor or control unit. The adaptor and control unit should be disconnected from the Bridge before electrical checks are made.

Transistor Adaptor Q801A

The transistor adaptor Q801A is a precision instrument and, though very robust, it should always be kept clean, and stored in its box

when not in use.

No action other than simple cleaning should be taken and it should be carried out with a lint-free cloth using a cleaning agent such as carbon tetrachloride.

No attempt should be made to repair the transistor adaptor, or to replace its components. If damaged, or if it does not pass the tests detailed in instructions 1(a) to 1(c), below, it should be returned to the factory for repair or replacement.

D. C. Control Unit Q801

The chassis of the control unit may be withdrawn from the cabinet by removing four screws one from each corner of the front panel. The construction and layout of the components is such that no difficulty will be experienced in checking connections and switches or replacing any faulty component. The small printed circuit board has component identifications marked on it and the remainder can be identified from the component locations shown in fig. 6, pp. 27 and 28.

Whenever the control unit is repaired it should be tested as detailed below, both alone and with the associated transistor adaptor. Test equipment required is:

Avometer Model 8
 Standard d. c. ammeter, e. g. C657, 1mA, 5mA, 20mA, 100mA, 200mA, 500mA, f. s. d.
 Standard d. c. voltmeter, e. g. C742, 1V, 2V, 5V f. s. d.
 Wayne Kerr Universal Bridge type B221A
 E. I. L. 20-million Megohm Meter Model 29C
 Resistors $\frac{1}{4}$ watt; one 10k Ω , two 50 Ω , each $\pm 0.5\%$

Electrical Checks

- 1 Check the inductance, resistance and capacitance of the adaptor as follows:
 - (a) Measure the inductance of the chokes (in the decoupling block assembly) LB1 LB2 LN1 and LN2 using a Wayne Kerr B221A and Q221A or B801B bridge. Check that they are all greater than 17 μ H.
 - (b) Check that the insulation resistance with 85V d. c. between the points listed

below is greater than $100\text{M}\Omega$.

A and N_2'	B_1' and B_2'
A and N_1'	N_1' and N_2'
A and B_1'	B_2' and N_1'
A and B_2'	B_2' and N_2'

When making these measurements the loader, without transistor, must be positioned in the adaptor from the front, in the left hand channel.

- (c) Measure the leakage resistance of the capacitors C_{B1} C_{B2} C_{N1} and C_{N2} at 85V d. c. In each case this should exceed $100\text{M}\Omega$. Measurements should be made between the connecting cable socket pins with the A, B and N faces of the adaptor base shorted together. The measurements are made between pins as follows:

1 and 2	1 and 4
1 and 3	1 and 5

2 Calibrate the voltmeter as follows:

- (a) Check that the four B1578 Ever Ready batteries are in good order and correctly inserted into their holding brackets in the chassis.
- (b) Turn the Set Volts (RV6) and Set Current (RV4) controls fully counter-clockwise and set the Volts F. S. D. switch to 0.3V and the Facility switch to D.
- (c) Adjust the potentiometer RV7 until the indicator reads 0V.
- (d) Turn the Set Volts control until 40mV is indicated on the meter and reduce this to zero with the potentiometer RV7.
- (e) Turn the Set Volts control until the meter reads 0.3V (f. s. d.). Place the standard voltmeter across terminals A and B_1 on the programme board. Adjust RV5 until the reading on the bias volts meter is within $\pm 1\%$ of the standard voltmeter reading.
- (f) Check that f. s. d. on each voltage range is within $\pm 1.5\%$ of the value shown by the standard voltmeter.

3 Calibrate the ammeter as follows:

- (a) Turn the Set Volts and Set Current controls fully counter-clockwise. Set the Facility switch to PNP and the mA F. S. D. switch to 1.
- (b) Set the Parameter switch to Y_{11} and connect the standard ammeter between A (positive) and B_2' on the programme board.
- (c) Turn the Set Current control for full scale deflection (1mA) and check that this is within $\pm 1\%$ of the value on the standard ammeter.
- (d) Set the mA F. S. D. switch to the other 3 ranges in turn and check that the f. s. d. value is within $\pm 1\%$ of that shown by the standard ammeter. Any adjustment should be done with RV3 on the 3mA range, RV2 on the 10mA range and RV1 on the 30mA range.

Transistor Adaptor and Control Unit Combined

- 4 Fit the transistor adaptor to a VHF Admittance Bridge B801B and connect the adaptor to the control unit with the 4 way cable as directed in the operating instructions 2 to 4, page 8. Source and Detector should not be connected to the bridge.
 - 5 Set the Facility switch to PNP, the mA F. S. D. switch to 1mA, the Volts F. S. D. switch to 10V.
 - 6 Set the Parameter switch to Y_{11} and insert a pnp transistor into the loader as directed in Table 1, p. 9.
 - 7 Set the Facility switch to Off and place the loader in the adaptor as directed in Table 1.
 - 8 Set the Facility switch to PNP and set up the bias conditions to 1mA and 10V. Repeat for all positions of the Parameter switch except D, altering the method of inserting the transistor and placing the loader in the adaptor as directed in Table 1. The same D. C. conditions should appear at all parameter settings without re-adjusting the controls.
- Note: The loader is always placed in the adaptor with the red dots uppermost.
- 9 Repeat with an npn transistor.
 - 10 Set the Parameter and the Facility switch to D.
 - 11 Insert a $1k\Omega \pm 0.5\%$ resistor (lead diameter max. 25thou.) into the loader using the black and green slots and place in the adaptor in the left channel from the front. Adjust the Set Volts control so that the voltmeter shows 10V and check that the current reading is $10mA \pm 4\%$.

12 Check 3-terminal operation as follows:

- (a) Make up a 3-terminal network as shown in fig. 5. The construction of the network should be as compact as possible. Lead diameters of not more than 0.025 in. and ± 0.5 per cent tolerance resistors should be used.

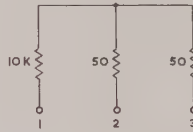


Fig.5 THREE TERMINAL NETWORK.

- (b) Set the source frequency to 30Mc/s. Insert the empty loader in the left hand channel in the adaptor and balance the bridge using the trim controls.
- (c) Insert the network into the loader in each of the two ways shown below using the left hand channel. Measure the conductance on the bridge. Check that the results equal the values in the 4th column of the table.

Network	Terminal	Numbers	Conductance Value
1	2	3	
Green	Black	Blue	10 millimhos $\pm 2\%$
Blue	Black	Green	10 millimhos $\pm 2\%$

- (d) Insert the network into the loader in the 3 ways shown in the table below, place the loader into the right hand channel with the red dots uppermost and measure the conductance on the bridge. Check that the results equal those shown in the 4th. column of the table.

Loader	Network	Terminal	Numbers	Conductance Value
	1	2	3	
Rear	Green	Blue	Black	10 millimhos $\pm 4\%$
Front	Blue	Red	Green	Trim for zero
Front	Black	Red	Green	0.05 millimho $\pm 10\%$

COMPONENTS LIST

Control Unit Q801

Ref No.	Value (ohms)	Tolerance %	Rating	Type	Maker
Resistors					
R1	10k	10	1/4W	Fixed comp.	Morganite S
R2	3.3k	10	1/4W	"	"
R3	1k	10	1/4W	"	"
R4	820	10	1/4W	"	"
R5	5	5	1/4W	Carbon H. S.	
R6	3	5	1/4W	"	
R7	13	1	1/4W	"	
R8	75	5	1/4W	"	
R9	68	1	1/4W	"	
R10	120	5	1/4W	"	
R11	800k	0.5	1/4W	"	
R12	280k	0.5	1/4W	"	
R13	80k	0.5	1/4W	"	
R14	28k	0.5	1/4W	"	
R15	4.7k	5	1/4W	"	
R16	820	10	1/4W	Fixed comp.	Morganite S
R17	12k	10	1/4W	"	"
R18	15k	10	1/4W	"	"
R19	56k	10	1/4W	"	"
R20	220k	10	1/4W	"	"
R21	33k	10	1/4W	"	"
R22	220	10	1/4W	"	"
R23	309k	10	1/4W	"	"
R24	125	5	5W	Wirewound	Radiospares
R25	820	5	5W	"	"
R26	22	10		Fixed comp.	Morganite S
R27	47	2		C21	Welwyn
Potentiometers					
RV1	25			Wirewound	Reliance
RV2	1K			"	"
RV3	2K			"	"
RV4	5K		3W	"	Colvern CLR 4001/11
RV5	10K			"	Reliance

Ref No.	Value (ohms)	Rating	Type	Maker
RV6 RV7	5K 10K	3W	Wirewound MP Dealer	Colvern CLR 4001/11 Plessey
Capacitors				
C1	8 μ F		Electrolytic MEW86 T 50V	Hunts
C2	2 μ F		M974/13	T. C. C.
Transistors				
VT1			OC201	Mullard
VT2			OC203	"
VT3			OC205	"
MR1			HS1010	Hughes
MR2			"	"
MR3			"	"
MR4			"	"
Indicators				
M1			1mA f. s. d.	Ernest Turner
M2			15 μ A f. s. d.	" "
Switches				
S1	Parameter		GA2	Plessey *
S2	Facility		"	" §
S3	mA f. s. d.		"	" †
S4	Volts f. s. d.		"	" ×
Batteries				
B1	12V		B1578	Ever Ready
B2	3 x 12V		B1578	" "

* Wayne Kerr Part No. D11865
 § " " " " D11864

† Wayne Kerr Part No. D11862
 × " " " " D11863

Transistor Adaptor Q801A

The shunt resistors provided are:

Resistor 10 Ω	$\pm 2\%$	Type 69C22	Welw
" 20 Ω	$\pm 2\%$	Type 69C22	"

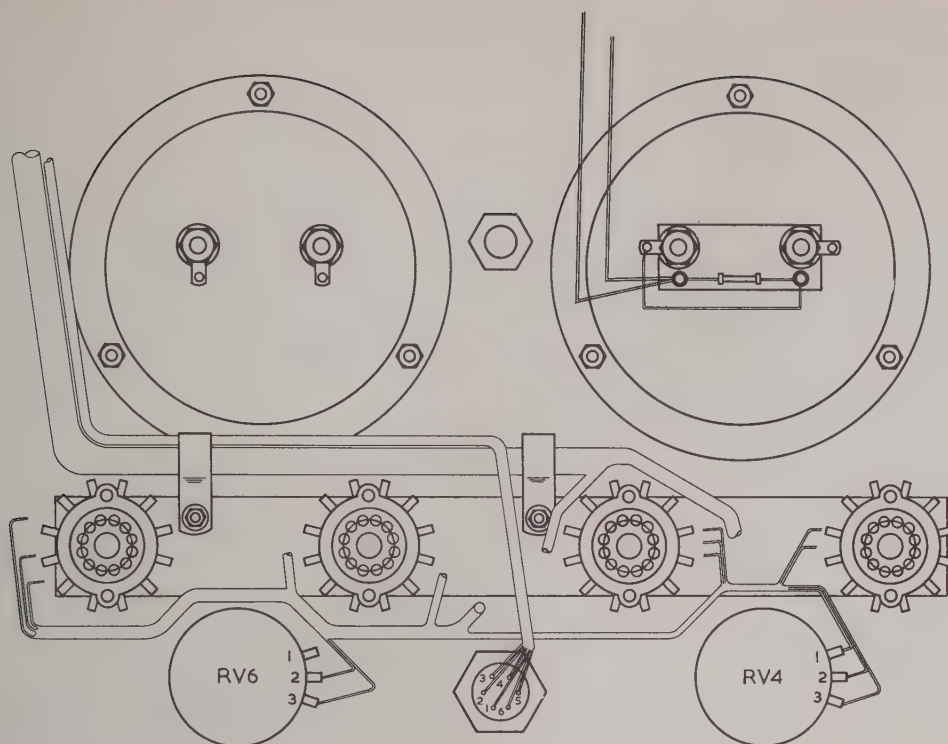
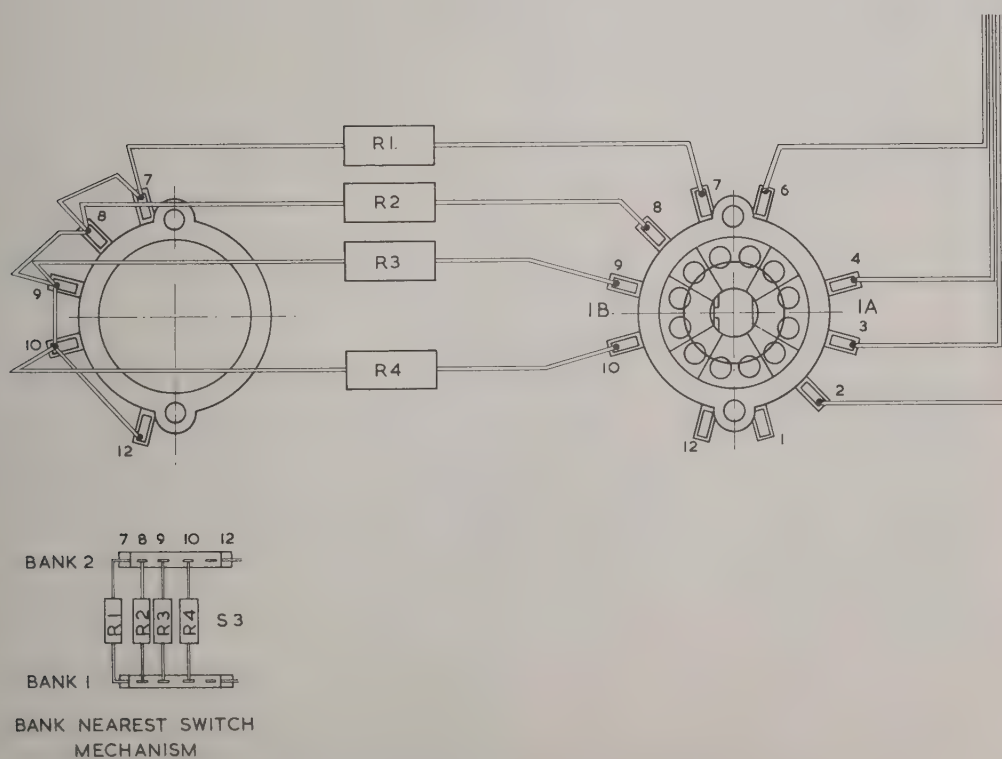


FIG. 6a FRONT PANEL ASSEMBLY.

FIG 6b. MILLIAMP SWITCH ASSEMBLY
(VIEWED FROM REAR)

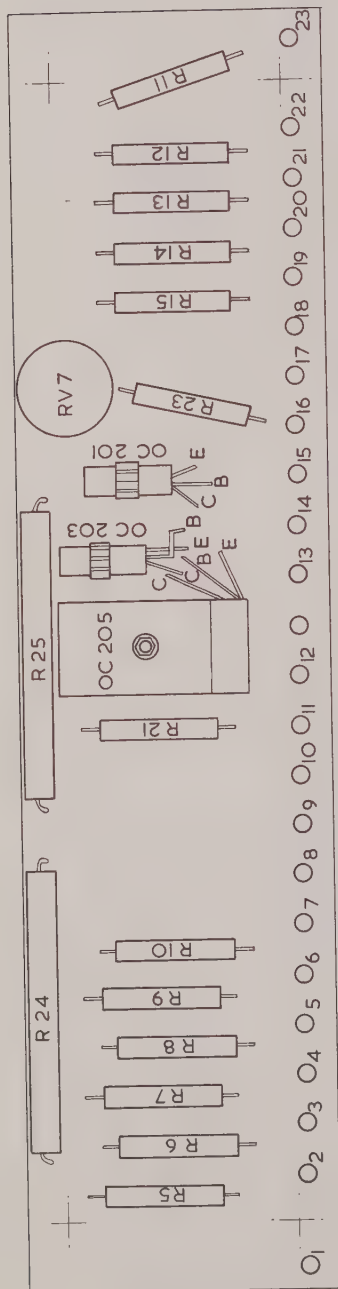


FIG. 6d. METERING PRINTED CIRCUIT BOARD.

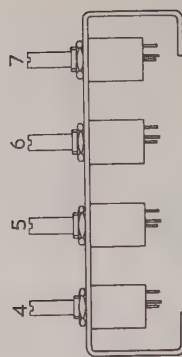
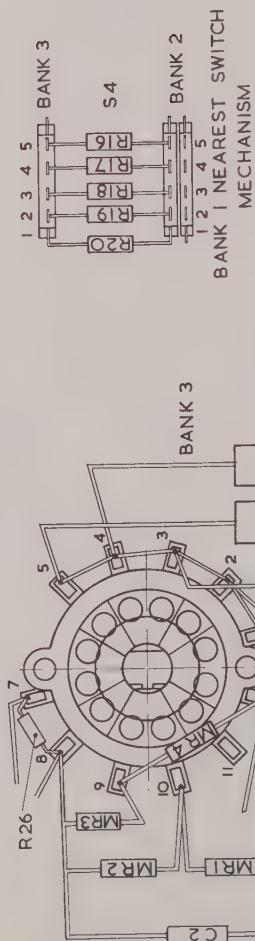
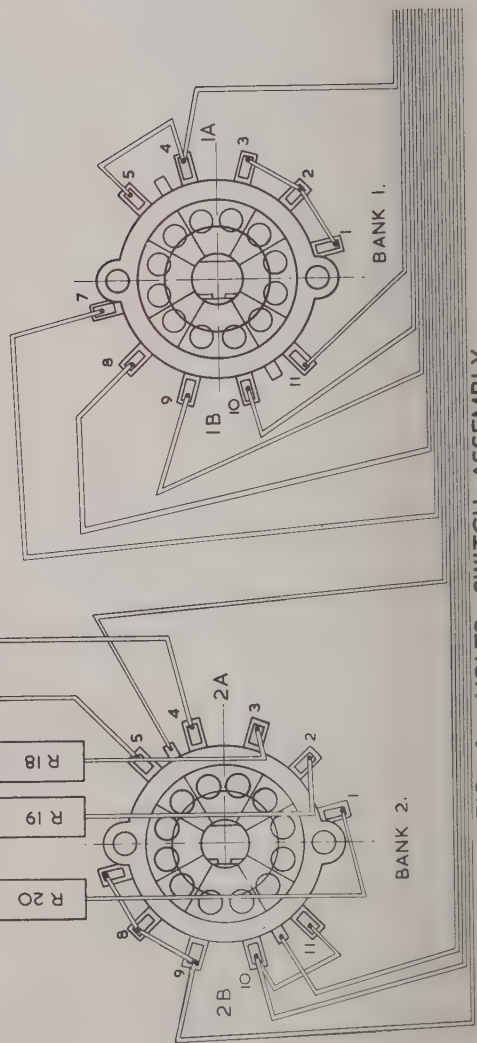
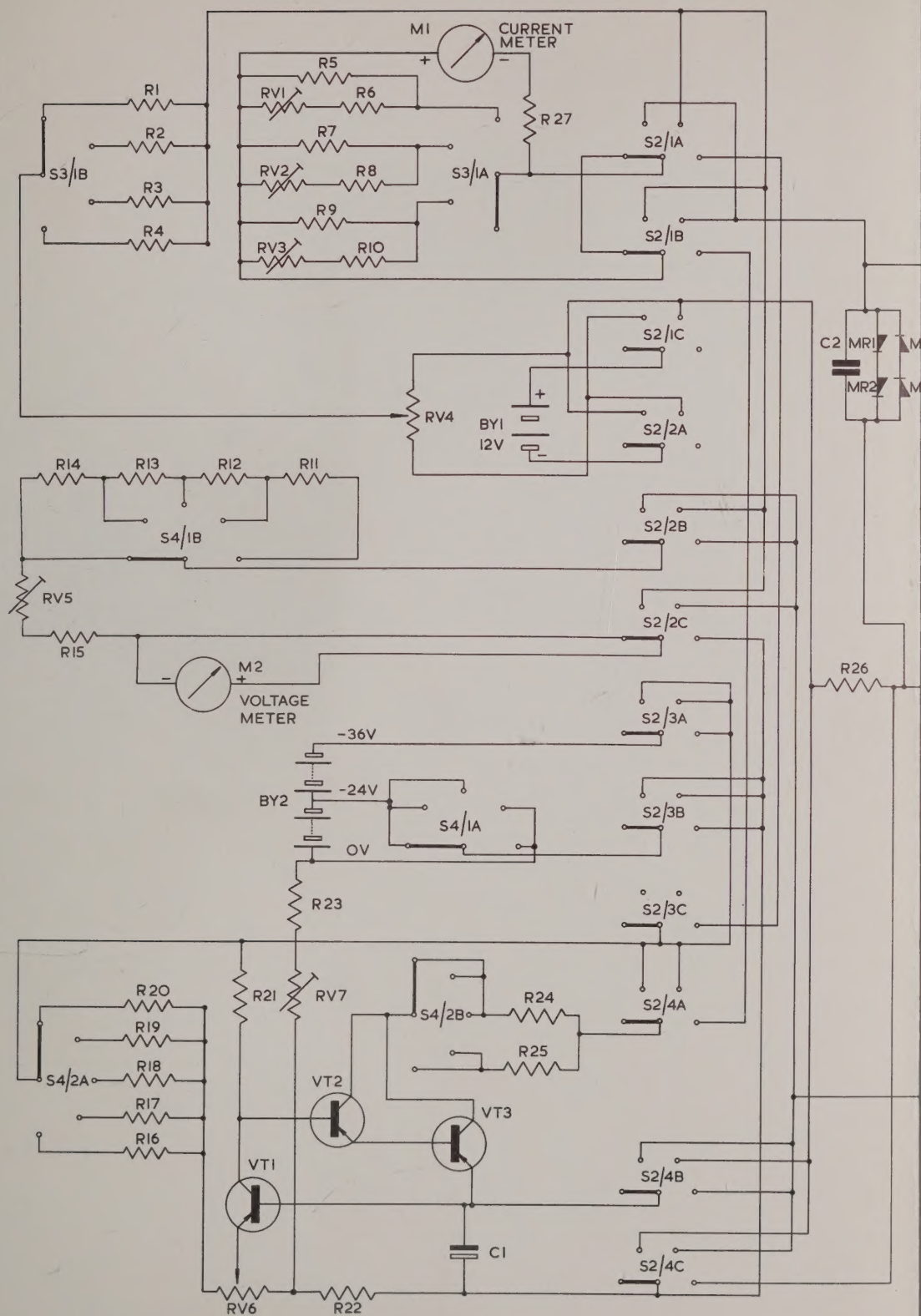
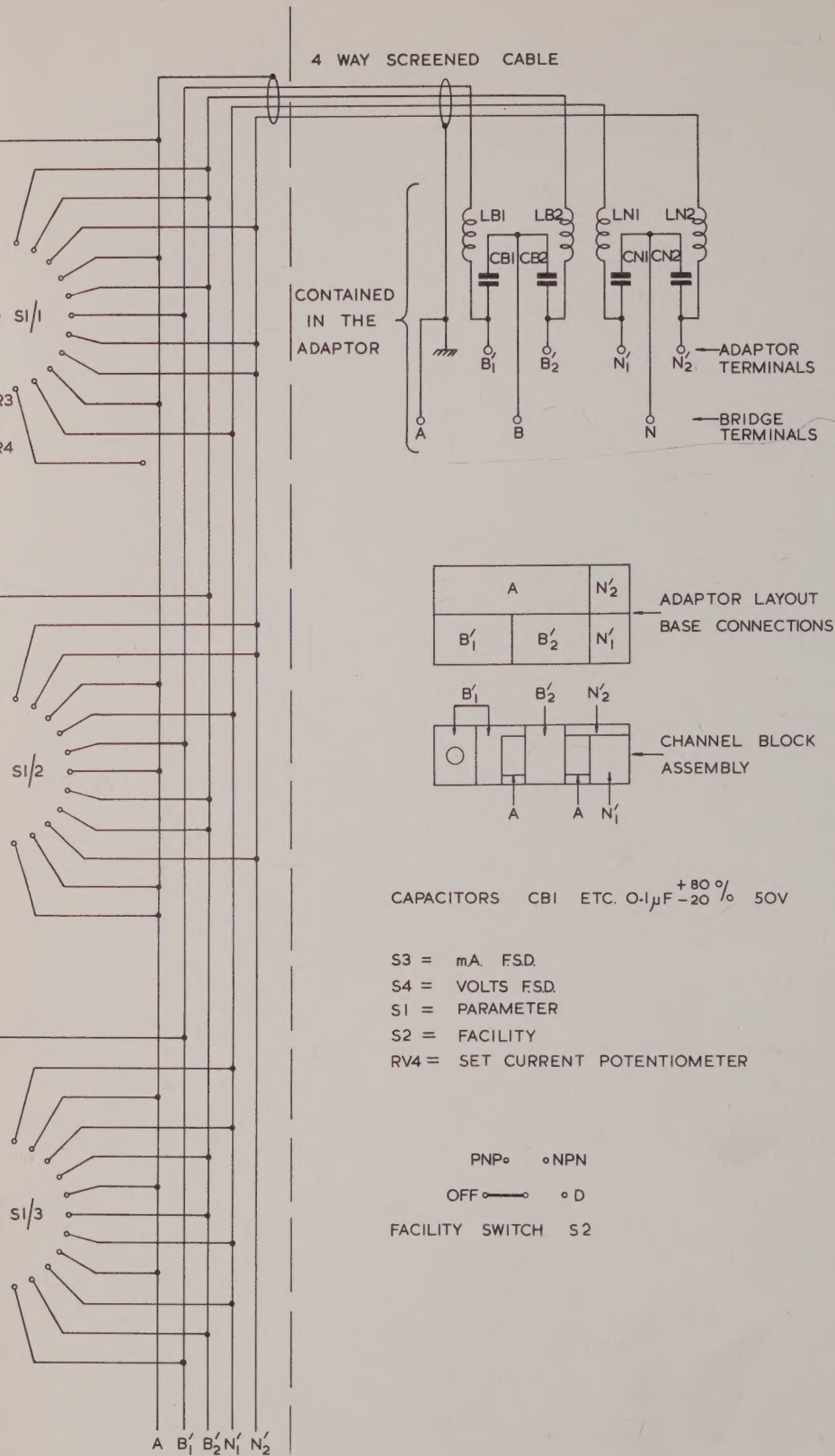


FIG. 6e. POTENTIOMETER BRACKET ASSEMBLY

FIG. 6c. VOLTS SWITCH ASSEMBLY.
(VIEWED FROM REAR)





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